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Water-Resources Investigations In Texas

Fiscal Year 1977

U.S. DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

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UNITED STATES

DEPARTMENT OF THE INTERIOR

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WATER-RESOURCES INVESTIGATIONS IN TEXAS FISCAL YEAR 1977

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WATER-RESOURCES INVESTIGATIONS IN TEXAS

FISCAL YEAR 1977

INTRODUCTION

Water-resources investigations in Texas (see enclosed map) consist of the collection of basic records through the hydrologic-data network, interpretive studies, and research projects. The basic-data records and the results of investigations are published by the Geological Survey or by cooperating agencies. This report describes the water-resources projects and activities of the Geological Survey in Texas for the 1977 fiscal year (October 1, 1976, to September 30, 1977).

The Geological Survey's investigations of the water resources of Texas are under the general direction of I. D. Yost, District Chief. The Texas District office is in the Federal Building, 300 East Eighth Street, Austin, Texas 78701.

Copies of unpublished records, basic data prior to publication, and other unpublished reports may be obtained from the District office by request.

Information regarding provisional records of stream discharge prior to publication and other hydrologic data collected within their respective areas may be obtained from the subdistrict offices in Austin, Fort Worth, Houston, San Angelo, San Antonio, and Wichita Falls. Requests for information should be addressed as follows:

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COLLECTION OF BASIC HYDROLOGIC DATA

A continuing series of measurements and analyses are made of streamflow, reservoir contents, and estuarine flow. In addition, data are collected on the chemical quality of water, sediment in streams and reservoirs, water levels in wells, and land-surface subsidence.

Modern computer techniques are being successfully used to collect, compute, and disseminate basic water data. By the end of the 1977 fiscal year, the following installations will be in operation: Approximately 570 digital recorders at stream-gaging, tide-level, and rainfall stations; 22 conductivity (digital) recorders; 7 instruments for continuously monitoring and recording the water-quality characteristics of conductivity, water temperature, dissolved oxygen, and pH; and 4 continous recorders for water temperature.

Surface-Water Records

Continuous-Record Streamflow and Reservoir-Content Stations

As of September 30, 1976, 553 stream-gaging, reservoir-content, and stage-only stations were in operation. During the 1977 fiscal year, 4 stream-gaging, and 2 reservoir-content stations will be established; and 20 stream-gaging, 2 reservoir-content, and 1 stage stations will be discontinued. At the end of the 1977 fiscal year, 536 continuous-record stations will be in operation.

Partial-Record Streamflow Stations

Low-flow partial-record stations.--As of September 30, 1976, 84 low-flow partial-record stations were in operation. During the 1977 fiscal year, no stations are scheduled to be established, but 11 stations will be discontinued.

Crest-stage partial-record stations.--As of September 30, 1976, 13 crest-stage partial-record stations were in operation. No additional stations are scheduled to be established during the 1977 fiscal year. One station is scheduled to be discontinued.

Flood-hydrograph partial-record stations.--As of September 30, 1976, 68 flood-hydrograph partial-record stations were in operation. Three stations are scheduled to be established during the 1977 fiscal year.

Flood-profile partial-record stations.--As of September 30, 1976, 12 flood-profile partial-record stations were in operation, with no additional stations scheduled to be established during the 1977 fiscal year.

Reconnaissance partial-record stations.--As of September 30, 1976, 18 reconnaissance partial-record stations were in operation. No additional stations are scheduled to be established or discontinued during the 1977 fiscal year.

Tide-level stations.--As of September 30, 1976, 57 tide-level stations were in operation. During the 1977 fiscal year, 9 additional stations are scheduled to be established. Twenty-one stations are scheduled to be discontinued.

Continuous Water-Quality Stations

As of September 30, 1976, 1 multiparameter water-quality monitor and 29 conductivity recorders were in operation. The monitor is located on the Trinity River, and the conductivity recorders are at stations in the Red, Neches, Brazos, Colorado, and Guadalupe River basins. Six conductivity recorders in the Red River basin will be discontinued during the 1977 fiscal year. Six multiparameter water-quality monitors are scheduled for installation in the Trinity River basin during the 1977 fiscal year. Four temperature recorders, one in the Trinity River basin, two in the Brazos River basin, and one in the Guadalupe River basin, are scheduled for installation in the 1977 fiscal year.

Daily Water-Quality Stations

Daily chemical-quality stations.--As of September 30, 1976, 121 daily chemical-quality stations were in operation. Sufficient samples were collected at these stations to define the total daily chemical loads. No new stations will be established.

Daily suspended-sediment stations.--As of September 30, 1976, four daily suspended-sediment stations were in operation. No additional stations are scheduled to be established.

Periodic Water-Quality Stations

Periodic chemical-quality stations.--As of September 30, 1976, the periodic chemical-quality network consisted of stations at 154 sites on streams and stations at 70 sites on reservoirs. During the 1977 fiscal year, only minor changes will be made in this network.

Special periodic water-quality sampling sites.--Special periodic sampling will be done during the 1977 fiscal year at 168 of the daily and periodic stations. The analyses will include determinations of standard chemical quality, BOD (biochemical-oxygen demand), DO (dissolved oxygen), NO_3 (nitrate), PO_4 (phosphate), pH, pesticides in unfiltered water samples and bottom deposits, and minor elements.

Periodic suspended-sediment stations.--A periodic suspended-sediment network of 35 stations was established in 1966. During the 1976 fiscal year, data collection at these stations was discontinued and a report summarizing the data for selected stations was prepared. During the 1977 fiscal year, data collection will begin at 18 new stations.

Lake and Reservoir Studies

The program for the 1977 fiscal year provides for four water-quality surveys of Town Lake (Austin); two surveys of Livingston Reservoir; and three surveys each of Wright Patman lake, Lake O' the Pines, Sam Rayburn Reservoir, Lake Arlington, Lewisville Lake, Cedar Creek Reservoir, Lake Conroe, Hubbard Creek Reservoir, Possum Kingdom Reservoir, Lake Granbury, Whitney Lake, Belton Lake, Somerville Lake, and International Falcon Reservoir. On-site determinations will be made of specific conductance, dissolved oxygen, temperature, and pH. Samples will be collected for laboratory analyses during each survey.

Summary of Scheduled Changes in Data Stations

Type of record: D--streamflow; H--flood-hydrograph partial record; Bp--periodic biologic; Op--periodic organic water quality; P--periodic pesticide; Qc--continuous-recording water-quality; Qp--periodic chemical quality; R--reservoir content

New Stations to be Established

Name of station	Type of record	Cooperation with USGS	Purpose of station and remarks
08036700 Lake Nacogdoches near Nacogdoches, Tex.	R	City of Nacogdoches through the Texas Water Development Board.	To provide a record of reservoir content and to furnish an inventory of water in storage in this basin.
08048543 West Fork Trinity River at Beach Street, Fort Worth, Tex.	DOpQc	North Central Texas Council of Governments.	To provide water-quality monitoring of an urban environment.
08049500 West Fork Trinity River at Grand Prairie, Tex.	DOpQc	do.	Do.
08056400 Trinity River at Westmoreland Road, Dallas, Tex.	DOpQc	do.	Do.
08057410 Trinity River below Dallas, Tex.	DOpQc	do.	Do.
08062000 East Fork Trinity River near Crandall, Tex.	DOpQc	do.	Do.
08062500 Trinity River near Rosser, Tex.	DOpQc	do.	Do.
08074760 Brays Bayou at Alief Road, Alief, Tex.	H	Harris County Flood Control District through the Texas Water Development Board.	Station was established for flood-hydrograph studies.
08074810 Brays Bayou at Gessner Drive, Houston, Tex.	H	do.	Do.
08091730 Squaw Creek Reservoir near Glen Rose, Tex.	R	Texas Utilities Services Inc. through the Texas Water Development Board.	To provide a record of reservoir content and to furnish an inventory of water in storage in this basin.
08105300 San Gabriel River near Weir, Tex.	DOpQp	Corps of Engineers, Fort Worth District	Station was moved upstream to this site because of vandalism at former site.
08174000 Guadalupe River near Gonzales, Tex.	H	do.	Station was requested by the Corps as an aid in flood forecasting on the Guadalupe River.
08181410 Ranch Creek near Helotes, Tex.	DBpOpPQp	Edwards Underground Water District through the Texas Water Development Board.	Station was established to provide necessary data on ground water - surface water interchange and to study the effects of urbanization.

Type of record: C--crest-stage partial record; D--streamflow; G--stage only; L--low-flow partial record; P--periodic pesticide; Bp--Periodic biologic; Op--periodic organic water quality; Qc--continuous-recording water quality; Qp--periodic chemical quality; R--reservoir content; S--daily sediment

Stations to be Discontinued

Name of station	Type of record	Cooperation with USGS	Reason for discontinuance
07299500 Prairie Dog Town Fork Red River near Estelline, Tex.	LQp	Corps of Engineers, Tulsa District	Sufficient data and samples have been collected to satisfy the project objectives.
07299505 Prairie Dog Town Fork Red River below Mountain Creek near Estelline, Tex.	LQp	do.	Do.
07299510 Prairie Dog Town Fork Red River above Jonah Creek near Estelline, Tex.	LQp	do.	Do.
07299514 Jonah Creek below weir near Estelline, Tex.	DQc	do.	Do.
07299516 Jonah Creek at mouth near Estelline, Tex.	LQp	do.	Do.
07308400 China Creek near Electra, Tex.	LQp	Texas Water Development Board	Do.
07311622 North Fork Wichita River near Crowell, Tex.	DQc	Corps of Engineers, Tulsa District	Do.
07311648 Middle Fork Wichita River near Truscott, Tex.	DQc	do.	Do.
07311780 South Fork Wichita River near Guthrie, Tex.	DQc	do.	Do.
07316200 Mineral Creek near Sadler, Tex.	DQp	Texas Water Development Board	Do.
08018950 Dry Creek near Quitman, Tex.	LQp	do.	Do.
08019400 Big Sandy Creek near Winnsboro, Tex.	L	do.	Sufficient data have been collected to satisfy the project objectives.
08020200 Prairie Creek near Gladewater, Tex.	DQp	do.	Sufficient data and samples have been collected to satisfy the project objectives.
08020700 Rabbit Creek at Kilgore, Tex.	DQp	do.	Do.

Stations to Be Discontinued--Continued

Name of station	Type of record	Cooperation with USGS	Reason for discontinuance
08031300 Flat Creek below Lake Athens near Athens, Tex.	L	Texas Water Development Board	Sufficient data have been collected to satisfy the project objectives.
08048000 West Fork Trinity River at Fort Worth, Tex.	OpQp	do.	Water-quality data collection moved to station at Beach Street.
08048540 Sycamore Creek tributary at Interstate Highway 35-W, Fort Worth, Tex.	D	City of Fort Worth	Lack of cooperative funds to continue project objectives.
08048550 Dry Branch at Blandin Street, Fort Worth, Tex.	C	do.	Do.
08052630 Little Elm Creek subwatershed No. 10 near Gunter, Tex.	D	City of Dallas through the Texas Water Development Board	Sufficient data have been collected to satisfy the project objectives.
08052650 Little Elm Creek near Celina, Tex.	DS	do.	Do.
08052700 Little Elm Creek near Aubrey, Tex.	DS	do.	Do.
08065700 Caney Creek near Madisonville, Tex.	D	Texas Water Development Board	Do.
08067580 Lake Conroe near Montgomery, Tex.	G	San Jacinto River Authority through the Texas Water Development Board	Lack of cooperative funds to continue project objectives.
08068400 Panther Branch near Conroe, Tex.	D	The Woodlands Development Corporation through the Texas Water Development Board	Do.
08068438 Swale No. 8 at Woodlands, Tex.	D	do.	Do.
08068440 Lake Harrison at Woodlands, Tex.	R	do.	Do.
08068450 Panther Branch near Spring, Tex.	DS	Texas Water Development Board	Do.
08079530 North Fork Double Mountain Fork Brazos River above Buffalo Springs Lake near Lubbock, Tex.	L	do.	Sufficient data have been collected to satisfy the project objectives.
08079551 North Fork Double Mountain Fork Brazos River below Buffalo Springs Lake near Lubbock, Tex.	L	do.	Do.

Stations to be Discontinued--Continued

Name of station	Type of record	Cooperation with USGS	Reason for discontinuance
08080910 White River Reservoir near Spur, Tex.	R	White River Municipal Water District through the Texas Water Development Board	Lack of cooperative funds to continue project objectives.
08090500 Palo Pinto Creek near Santo, Tex.	D	None	Sufficient data have been collected to satisfy the project objectives.
08105400 San Gabriel River near Circleville, Tex.	D	Corps of Engineers, Fort Worth District	Necessary to discontinue operation of this station at site because of vandalism.
08159100 Onion Creek below Del Valle, Tex.	LBpOpPQp	City of Austin and the Texas Water Development Board	Data collection moved to station at U.S. Highway 183.
08435600 Toronto Creek near Alpine, Tex.	DQp	Corps of Engineers, Albuquerque District	Lack of cooperative funds to continue project objectives.
08435620 Alpine Creek at Alpine, Tex.	DQp	do.	Do.
08435660 Moss Creek near Alpine, Tex.	DQp	do.	Do.

Ground-Water Records

A network of wells for observing fluctuations in ground-water levels, changes in the chemical quality of ground water, and subsidence of the land surface is maintained in areas of large-scale ground-water development. The periodic collection of ground-water data can be used in solving such specific problems as over-development and its relation to pumping costs, relationship of recharge to discharge of an aquifer, and the relationship of the quality of ground water to the development and use of the water.

The observation-well network is confined to the areas of continuing ground-water studies in the Houston district and adjacent areas, San Antonio area and Balcones Fault Zone, El Paso area, and Orange County and adjacent areas. As of September 30, 1976, the Geological Survey was monitoring more than 1,200 wells. The types and numbers of observation wells programed for the 1977 fiscal year by areas are as follows:

Area	Water levels		Chemical quality	Subsidence
	Periodic	Continuous		
Houston area	700	9	125	10
San Antonio area and Balcones Fault Zone	8	10	60	0
El Paso area	205	9	20	0
Orange County and adjacent areas	98	2	58	0

PROJECT STUDIES

Hydrologic Studies of Small Watersheds

The U.S. Soil Conservation Service (SCS) has an extensive program of constructing floodwater-retarding structures in small watersheds in Texas. These structures, which are designed to control floodflows and sediment movement, will have varying but important effects on the natural surface- and ground-water resources of river basins, especially where a large number are built. The need has grown for basic hydrologic data on these small watersheds to compare the hydrology under natural and developed conditions. It is, therefore, essential that the hydrologic studies determine the extent to which the floodwater-retarding structures affect the volume and mode of occurrence of runoff.

The specific objectives of these studies are:

(1) To determine the net effect of floodwater-retarding structures on the regimen of streamflow at downstream points.
(2) To determine the effectiveness of the structures as ground-water recharge facilities.
(3) To determine the effect of the structures on the sediment yield at downstream points.
(4) To develop relationships between runoff and rainfall in small natural watersheds.
(5) To develop stream-system models for basins with floodwater-retarding structures.
(6) To determine the minimum instrumentation necessary for estimating the flood hydrographs below a system of structures, as needed for downstream water-management operations.

Hydrologic studies of SCS-developed areas in Texas, which were started in 1951, have been made by the Geological Survey in 12 small watersheds to provide the needed data for analyses. The U.S. Soil Conservation Service, Texas Water Development Board, San Antonio River Authority, city of Dallas, and the Tarrant County Water Control and Improvement District No. 1 cooperated with the Geological Survey in these studies. The 12 study areas were chosen on a statewide basis to sample watersheds having different rainfall, topography, geology, and soils. In five of the study areas, streamflow and rainfall records were collected prior to construction of the floodwater-retarding structures, thus affording the opportunity for analyses of the hydrologic conditions before and after construction.

The 12 study areas, which are in four major river basins, are North Creek, Elm Fork Trinity River, Little Elm Creek, Honey Creek, and Pin Oak Creek, all in the Trinity River basin; Green Creek, Cow Bayou, Little Pond-North Elm Creeks, in the Brazos River basin; Deep and Mukewater Creeks in the Colorado River basin; and Escondido and Calaveras Creeks in the San Antonio River basin.

During the period 1967-76, the data-collection phases of the studies were discontinued in all but the North Creek study area. As funds and manpower become available, interpretive reports on the studies in each area are to be prepared. Data collection in the North Creek study area will continue during fiscal year 1977.

Urban-Hydrology Studies

Society is confronted with the most urgent water problems in urban areas, where residential, commercial, and industrial complexes may be subject to potentially destructive floods and where lives and vast sums of money can be saved if metropolitan drainage systems and water-control facilities are properly planned.

Because undeveloped land is being converted to urban use, the amount of impervious surface area is increased, which results in a change in the runoff pattern. Higher peak discharges may result. Drainage systems that were constructed prior to urbanization may need to be redesigned to function properly under conditions of ultimate land development. Because of these requirements, hydrologic data are needed to define the effects of urbanization on the magnitude of floodflow from small drainage areas. Data are also needed to define the quality of storm runoff from urban watersheds.

The Geological Survey, in cooperation with State and local agencies, is making hydrologic studies in the Austin, Dallas, Dallas County, Fort Worth, Houston, and San Antonio areas. These studies will provide data necessary for defining the changes in storm runoff resulting from progressive urban development and for defining flood boundaries and depths of inundation for floods of various magnitudes and frequencies. In the Austin, Houston, and San Antonio areas, water-quality data are obtained for studies of streamflow pollution by the urban environment.

Austin Project

The Austin project began with a very small program in 1954 in cooperation with the Texas Water Development Board. The project initially involved the collection of rainfall and runoff data in the Waller Creek basin, a 4.13-square-mile urban watershed in Austin. Collection of rainfall and runoff data was started in 1963 in the Wilbarger Creek basin, a 4.61-square-mile rural watershed 15 miles northeast of Austin. The data collected in the Wilbarger Creek area, which is comparable in size, climate, and geology to the Waller Creek study area, will be used for comparison to infer hydrologic effects of urban development.

Data are being collected from three recording rain gages and from two continuous-record stream-gaging stations in the urban watershed of Waller Creek. Three recording rain gages and one continuous-record stream-gaging station provide data for the Wilbarger Creek watershed.

During 1975, data collection in the project in cooperation with the city of Austin was expanded to include: 19 additional sites for streamflow (14 for flood hydrograph, 2 for continuous record, and 3 for periodic measurements with water-quality samples), 12 additional recording rain gages, 8 sites for water-quality sampling of streamflow, and seasonal intensive water-quality surveys of Town Lake. These additional data-collection sites are located in the Bull, Barton, Bouldin, Shoal, Boggy, Walnut, Williamson, and Onion Creeks watersheds, which are tributary to the Colorado River.

Data collection during the 1976 fiscal year was further expanded to include five additional sites for streamflow (four for flood hydrograph and one for continuous record) and four recording rain gages in the Bull, Bee, and Onion Creeks watersheds.

During the 1977 fiscal year, data collection will continue at the established sites. Basic-data reports, which contain graphical and tabular data on the rates and volumes of rainfall and runoff from major storms, tables of daily runoff at selected sites, and tables showing the quality of the streamflow and the storage in Town Lake, will be prepared annually.

Dallas Project

The Dallas project, which began in 1961, is in cooperation with the city of Dallas. During the 1973 fiscal year, the following changes were made: Data collection at 87 flood-profile gages, 7 recording rain gages, and 1 flood-hydrograph gage was discontinnued; and data collection began at 3 flood-hydrograph gages. An interpretive report "Effects of urbanization on floods in the Dallas, Texas, metropolitan area," based on data collected in the project through September 1970, was completed during fiscal year 1974.

During the 1974 fiscal year, data collection was expanded in the Fivemile Creek drainage basin by the establishment of three flood-hydrograph (dual-digital) type stations and two weighing-type rainfall stations. Collection of rainfall and flood-stage or discharge data was also continued at 6 continuous-record stream-gaging stations, 13 flood-hydrograph stations, 2 flood-profile stations, and 29 recording rain-gage stations (including 9 gages at partial-record stations). This extensive hydrologic network covers the White Rock Creek, Turtle Creek, Bachman Branch, Joes Creek, Fivemile Creek, Cedar Creek, and Coombs Creek watersheds in Dallas.

Data collection during the 1976 fiscal year was further expanded to include the Prairie Creek drainage basin. One continuous-record stream-gaging, two flood-hydrograph (dual-digital), and two weighing-type rainfall stations were established.

During fiscal year 1977, data collection will continue in the established network. Basic-data reports, presenting graphical and tabular data for rates and volumes of rainfall and runoff for selected storms during the year, will continue to be prepared annually.

Dallas County Project

The Dallas County urban hydrology study was initiated during the 1969 fiscal year in cooperation with the Dallas County Department of Public Works. The study area constitutes all of Dallas County exclusive of the city of Dallas and contains many rapidly urbanizing communities.

The initial data-collection network consisted of 1 continuous-record streamflow, 2 flood-hydrograph (dual-digital), 6 weighing-type rainfall, and 21 flood-profile crest-stage stations. These stations were located in the Duck and South Mesquite Creeks watersheds.

During the 1970 fiscal year, the network was expanded by instrumenting Tenmile Creek watershed with one continuous-record streamflow station, eight flood-profile crest-stage gages, and five weighing-type rain gages and by adding a streamflow station and three flood-profile crest-stage stations in the Duck Creek watershed.

Data collection during the 1977 fiscal year will continue in the established network. Data collected in this project are included with those published annually for the Dallas project.

Fort Worth Project

The Fort Worth project was initiated during the 1969 fiscal year in cooperation with the city of Fort Worth. The data-collection network now consists of 5 continuous-record streamflow, 2 flood-hydrograph, 10 weighing-type rainfall, and 43 crest-stage flood-profile stations. These stations are located in the Little Fossil Creek, Dry Branch, and Sycamore Creek watersheds.

During 1970, the data-collection network was expanded by the addition of three continuous-record streamflow stations and four recording rain gages in the Sycamore Creek watershed and a special study area (Seminary South Shopping Center). During the 1971 fiscal year, 16 crest-stage flood-profile stations were added in the Sycamore Creek watershed.

During the 1977 fiscal year, a reduction in scope of data collection will be made. One continuous-record and one flood-hydrograph station will be discontinued. Four additional continuous-record stations will be converted to flood-hydrograph stations. The Corps of Engineers, Fort Worth District, will assume financing of the data collection in the project during 1977. Basic-data reports will be published annually.

Houston Project

The Houston project, which began in 1964, is in cooperation with the city of Houston and the Texas Water Development Board. The data-collection network initially consisted of 7 continuous-record stream-gaging stations, 17 flood-hydrograph partial-record stations (each having recording rain gages), and 5 weighing-type recording rain gages.

The program was expanded during the 1969 fiscal year to include collection of water-quality data on the chemical quality, nutrients, BOD, pesticides, and sediment at five sites. During the 1972 fiscal year, periodic chemical-quality samples were collected at 6 additional sites, and samples for coliform bacteria counts and minor-element analyses were collected at 17 sites. The program was also expanded in 1972 to include collection of streamflow quality and quantity data before development of a planned "satellite town" in the Panther Branch drainage basin about 25 miles north of Houston.

Program changes in fiscal year 1973 included discontinuing 9 of the 17 flood-hydrograph partial-record stations, installing 8 additional weighing-type recording rain gages, and collecting additional samples for water-quality studies. Data collection in the project through September 1969 afforded analyses that resulted in a report "Effects of urbanization on floods in the Houston, Texas, metropolitan area" published in April 1973.

During the 1977 fiscal year, all data collection in the Panther Branch drainage basin will be discontinued.

Analyses requisite to updating the report "Effects of urbanization on floods in the Houston, Texas, metropolitan area," will be made in 1977, with a report summarizing the analyses scheduled for 1978. Analyses will also be made in 1977 to define a water-quality model for the Houston urban area. A report summarizing the model will be published in 1978.

Basic-data reports, presenting graphical and tabular data for rates and volumes of rainfall and runoff each year and the quality of the streamflow will continue to be prepared annually.

San Antonio Project

The San Antonio project was initiated in 1968 in cooperation with the Texas Water Development Board with a data-collection network of: Three continuous-record streamflow, four flood-profile, six flood-hydrograph (dual-digital), and nine recording rainfall stations. The data-collection program was expanded during the 1969 fiscal year to include samples collected and analyzed periodically from 11 streamflow sites. Results of these analyses will be included in the annual basic-data reports. Analyses scheduled are: Standard chemical; nutrients; BOD; pesticides; and sediment. The program for 1971 was expanded slightly by the addition of a sediment station at Olmos Creek at Dresden Drive. In 1972, the gaging station at Olmos Reservoir was discontinued. In 1976, two flood-hydrograph stations with rain gages (dual-digital) were established in the Elm Creek watershed.

Data collection during the 1977 fiscal year will be expanded to include a continuous-record and water-quality station on Ranch Creek. Basic-data reports presenting graphical and tabular data for rates and volumes of rainfall and runoff each year and the quality of the streamflow will continue to be published annually.

Flood Stages and Discharges for Small Streams in Texas (Highway Program)

The highway program, which began in 1965, is in cooperation with the Texas Department of Highways and Public Transportation and the U.S. Department of Transportation, Federal Highway Administration. The objective of the project is to define the frequency and magnitude of floods on small rural watersheds having drainage areas of less than 20 square miles. This information is needed to establish criteria for properly designing culverts and bridges on highways. Toward this end, 150 crest-stage partial-record stations have been established throughout Texas. Data on flood magnitudes and volumes and on rainfall amounts and intensities are being obtained at each station.

The first report--a compilation of all peak-discharge data collected in Texas through September 30, 1963, for streams draining about 100 square miles--was printed in 1966. This report, entitled "Floods on small streams in Texas" was released in January 1966 as a U.S. Geological Survey open-file report. Eight additional reports containing data for water years 1964-72 have been completed.

During the 1974 fiscal year, a report entitled "Estimating the magnitude of peak discharges for selected flood frequencies on small streams in East Texas" was prepared and distributed as an open-file report. The report contains regression equations for the computation of peak discharges at ungaged sites on small streams generally east of the 98th meridian.

All data collection under this project was discontinued September 30, 1974. Funds previously used for data collection were used in data analyses aimed at statewide definition of flood characteristics. Completion of analyses and preparation of an appropriate report is scheduled during the 1977 fiscal year.

Chemical and Physical Characteristics of Water in Estuaries of Texas

This study, begun in October 1967, is in cooperation with the Texas Water Development Board. The objectives of the study are to collect data on water temperature, pH, dissolved constituents, concentration of nutrients (phosphorus and nitrogen compounds), minor elements, water velocities and directions, and other data necessary to define the source and distribution of nutrients, current patterns and rates of movement, and the physical and organic water quality in areal distribution and time variation.

Two water-quality surveys for 10 estuaries from Port Arthur to Port Isabel will be made during fiscal year 1977. Ten additional water-quality surveys during low or moderate floods will be made for the Trinity-San Jacinto and Sabine-Neches estuaries.

Special investigations to determine the quantity and quality of fresh-water inflow and the exchange of water between the Trinity-San Jacinto estuary and the Gulf of Mexico were made during July 1976.

To supplement available tide-stage records being obtained by the U.S. Army Corps of Engineers, thirty-one additional tide and (or) estuary stage gages are operated as part of the cooperative program with the Texas Water Development Board.

The basic data will be released to interested agencies on as timely a basis as possible and will be released in an annual basic-data compilation. Interpretive reports will be prepared as the data warrant.

Pesticides Program

The Geological Survey collects, at quarterly intervals, samples for pesticides analyses from a network of stations on streams throughout the western states. Fifteen stations in Texas are included in the network.

Programs in cooperation with the Texas Water Development Board provide for studies of the quantities of chlorinated hydrocarbon pesticides in water and bottom sediments at a network of surface-water stations, in runoff in the Austin, Houston, and San Antonio urban areas, and in selected wells in counties where ground-water studies are in progress.

Continuing Ground-Water Studies

The continuing ground-water studies are detailed studies that are designed to keep abreast of and to evaluate the effects of large withdrawals of ground water in the areas of concentrated pumping. The need for ground-water information in these areas is determined by the particular problems of the area, and the programs of continuing study are carefully planned to meet specific objectives.

Houston Area

The ground-water study in the Houston area, which began on a more or less continuous basis in 1929, is in cooperation with the Texas Water Development Board and the city of Houston. The program proposed for 1977 is a continuation of basic-data collection. Items of work will include an inventory of all new large-capacity wells; periodic measurements of water levels in about 700 observation wells; operation and maintenance of 9 continuous water-level recorders and 10 compaction recorders; collection of water samples annually from about 125 wells for chemical analyses; conducting pumping tests on new large-capacity wells; and an inventory of annual municipal, industrial, and irrigation pumpage.

El Paso Area

The ground-water study in the El Paso area began in 1935 in cooperation with the Texas Water Development Board and the city of El Paso. The program for the 1977 fiscal year is in two parts. The first part of the program consists of a continuation of the collection of basic hydrologic data in the Hueco Bolson and Mesilla Valley; measuring 205 wells annually, 25 quarterly, 4 monthly, and 9 continuously with water-level recorders; inventorying all new wells (excluding shallow irrigation wells); making aquifer tests in large-capacity wells; collecting water samples from about 20 wells; and determining maximum peak demand that could be supplied by wells at various spacings in the Hueco bolson.

The second part of the program consists of developing, calibrating, and interrogating a digital model of the lower Mesilla Valley.

San Antonio Area and Balcones Fault Zone

The ground-water study in the San Antonio area and Balcones Fault Zone, which began in 1949, is in cooperation with the Texas Water Development Board and the Edwards Underground Water District. The objectives of the study are to appraise quantitatively the ground-water resources in the San Antonio area and along the Balcones Fault Zone from Kinney County to the Hays-Travis County line and to continue to investigate the cause and effect relationships in the Edwards aquifer.

The 1977 program consists of continuing to collect and analyze the basic geologic and hydrologic data and to refine the previous evaluations. Items of work include the periodic measurements of water levels in 8 wells; operation and maintenance of continuous water-level recorders on 10 wells; collection of 60 samples for some but not all inorganic, biologic, and minor elements and pesticides; inventory of all large-capacity well pumpage and spring discharge; inventory of new wells; and mapping of the principal recharge area of the Edwards aquifer. A basic-data report and a report discussing the extent of pollution in the aquifer will be prepared for release in fiscal year 1977.

Orange County and Adjacent Areas

The ground-water study in the Orange County area, which began in 1967, is in cooperation with the Texas Water Development Board and the Sabine River Authority of Texas. The purpose of this study is to keep abreast of the effects of ground-water development in the area and especially to monitor the fresh water - salt water interface as a guide to future development of ground water in Orange and adjacent counties to prevent further saltwater intrusion. The magnitude of industrial and municipal development in the area greatly increases the gravity of the situation.

The 1977 fiscal-year program will consist of the inventory of all new large-capacity wells, including the collection of drillers' logs, electrical logs, and well-construction information; measurements of water levels in about 98 observation wells on a semi-annual basis; operation and maintenance of two continuous water-level recorders; and the location of additional wells suitable for water-level recorders. In addition, water samples from about 58 wells are to be collected annually for chemical analyses; annual municipal and industrial pumpage is to be inventoried; and all data currently and previously collected are to be analyzed, interpreted, and correlated.

Other Interpretive Studies

Artificial-Recharge Research on the High Plains of Texas and New Mexico

This research project, which began during the 1968 fiscal year, is financed wholly by Federal funds. The study will provide information needed in connection with artificial recharge of water obtained from the playa lakes or imported to the High Plains. The study is also providing the opportunity for applied research on methods of artificial recharge. During the 1977 fiscal year, recharge from the surface through spreading ponds will be continued. Additional work is being done on problems associated with recharge through wells, such as the control of sediment in recharge water. Reports on specific aspects of the recharge studies will be prepared when warranted.

Water Resources of Guadalupe Mountains National Park

This study was begun during the 1969 fiscal year in cooperation with the National Park Service. The objectives are to appraise the water resources of this newly established park. Because the present water supply of the area--obtained from wells and springs--is inadequate for anticipated needs, the study will include a complete inventory of wells and springs with particular attention to those areas of immediate need (Frijoles Ranch site, McKittrick Canyon, and the Bowl). In 1977, an evaluation of the adequacy of springs in the northern part of parks as sources of water for park use will be made.

Hydrologic-Research Studies of the Edwards and Associated Limestones

This ground-water study is in cooperation with the Texas Water Development Board, the Edwards Underground Water District, and the San Antonio City Water Board. All indications, both past and present, show that the Edwards aquifer will, in time, become totally developed (in the amount of the natural recharge), and that it will then become necessary to integrate the use of water from the Edwards with water imported from other sources. At that time, it will be necessary to know in as much detail as possible how to get the most water from the Edwards with least waste, with a minimum conflict between users, and with a minimum detriment to those users who are in less favorable locations.

This study will provide for the complete appraisal of the availability of water in the Edwards aquifer, thereby furnishing valuable and detailed information not now available to all agencies that may be concerned with water management.

The program for 1977 will emphasize the analyses and interpretation of the test-well data in terms of reservoir characteristics. The program will also include: (1) Documentation and duplication of file data; (2) preparation of cross sections; (3) an evaluation of streamflow records to determine recharge; (4) the collection of water samples for stable and radioactive-isotope analyses, including tritium; (5) collecting about 10 water samples primarily from along or near the "bad-water" line; and (6) packer testing to locate and evaluate zones of flow.

Digital-Model Study of the Chicot and Evangeline Aquifers of the Texas Gulf Coast

The rapidly increasing demands on the ground-water resources in the Gulf Coast area has made it necessary to evaluate the major aquifers along the Gulf Coast of Texas. The ultimate product of the study will be a digital model, which will serve as a guide for the regional development and protection of the aquifers.

The study will be conducted in several phases, the first of which consists of an evaluation of the ground-water supplies in Colorado, Lavaca, and Wharton Counties. The program for 1977 includes: (1) A report on the three-county area (phase I); (2) the collection of basic data needed for the model for the eastern and central parts of the Gulf Coast; (3) completion of digital model of the Houston area and begin development of a model for the eastern section of the Gulf Coast; and (4) determining feasibility of a model for the lower part of the coastal area.

Rio Grande Environmental Study

The present water needs (exclusive of irrigation) of the El Paso area are supplied almost entirely from ground-water sources. The known available supplies of fresh ground water are large, but for future growth, additional sources of water need to be identified. The study will provide information on the amounts and quality of fresh and slightly saline ground water available for development in the Salt Basin, Quitman and Presidio Bolsons, Mesilla Valley, and La Mesa Bolson.

The 1977 program, in cooperation with the Texas Water Development, will consist of the completion of the final report.

Maps of Flood-Prone Areas in Texas

The U.S. Geological Survey is mapping flood-prone areas in Texas by showing the approximate boundaries of the areas subject to inundation by a 100-year flood on topographic maps, which means that on the average, there is about 1 chance in 100 that the delineated areas will be flooded in any year. These flood-prone areas are shown on existing topographic maps, with the names listed under "quadrangle" indicating the name assigned by the Geological Survey. This program is part of a nationwide Federal program designed to aid in reducing flood losses. Within the Geological Survey program, 122 quadrangles were completed through June 1976, with an additional eight quadrangles to be completed during the 1977 fiscal year. A list of quadrangles completed and presently available for the 1976 fiscal year are as follows:

Bogata	Lone Star
Callisburg	Iraan
Coahoma	Seminole
Linden	Woodbine

In addition to the 122 quadrangles completed through June 30, 1976, within the Geological Survey program, a cooperative program was developed with the Department of Housing and Urban Development in which an additional 328 7-1/2-minute quadrangles were completed in 1973, and 208 7-1/2-minute quadrangles were completed in 1974, bringing the total quadrangles mapped in Texas to 658 through September 30, 1976. A list of those quadrangles completed can be obtained from the District Office.

Flood-Insurance Studies

The U.S. Geological Survey, in cooperation with the Department of Housing and Urban Development, is making detailed comprehensive flood studies to establish flood insurance actuarial rates within the State of Texas.

A list of these studies to be completed during the 1977 fiscal year are given below:

Denton	Hurst	Bexar County
Alamo Heights	Shavano Park	Terrell Hills
Pasadena	Deer Park	Alvin
Balcones Heights	Castle Hills	Converse
Elmendorf	Grey Forest	Hollywood Park
Kirby	Selma	Amarillo

Trinity River Time-of-Travel Study

The purpose of these studies is to provide data to the Trinity River Authority to develop a mathematical model of the water quality of the Trinity River. The model is being developed as part of a comprehensive water-quality management plan for the Trinity River basin.

Three time-of-travel studies have been completed. The results of the first two studies have been released in open-file reports. The first study, for the period July 31 to August 1972, covered a reach of the West Fork Trinity River between Fort Worth and Dallas and two reaches of the main stem of the Trinity, one from Dallas to the upper end of Livingston Reservoir and the other from below Livingston Dam to Liberty. The second study, in September 1973 and July-August 1974, included parts of the West Fork Trinity River and the main stem of the Trinity River. The third study, which was made in December 1975, covered the Elm Fork Trinity River downstream from Lewisville Dam and the East Fork Trinity River downstream from Forney Dam. The results of the last study were released in January 1977.

Miocene Aquifer Study - Gulf Coast Region of Texas

The increasing demands on the ground-water resources of the Texas Gulf Coast require a more detailed evaluation of the potential of the Miocene aquifers as a source of water supply. The study will result in a digital model that will serve as a useful tool to aid water planners in the regional development of these aquifers.

The 1977 program will include: (1) Collection and compilation of basic data for input to the model; (2) preparation of isopachous and potentiometric maps; and (3) determination of hydrologic parameters for the model.

Land-Surface Subsidence in the Texas Gulf Coast Area

Land-surface subsidence is occurring over a large part of the Texas Gulf Coast. As a result, part of the coastal area is subject to flooding by normal tides, and even larger areas may be inundated by hurricane tides.

The study, which began in 1976, is divided into two parts. Part I will determine the extent of subsidence from available data throughout the Texas coastal areas, and Part II will determine the effect on the rate of subsidence resulting from a decrease in ground-water extraction in Harris and Galveston Counties.

Sources of Saline Water in the Upper Colorado River Basin

The segment of the Colorado River between Colorado City and Lake J. B. Thomas has long been known to contain high concentrations of salt. Recent investigations suggest that controls on disposal of oilfield brine, diversion of saline water, and other remedial measures are improving the quality of water in the Colorado River. The purposes of this study, in cooperation with the U.S. Army Corps of Engineers, are to delineate the areas of saline inflow and to determine if the quantities of salt reaching the upper Colorado River are decreasing.

Drainage-Area Determinations

The objective of this project is to determine the drainage areas of all major streams in Texas. After drainage-area determinations are completed, the results are compiled, by river basin, in open-file reports that will serve to eliminate the use of conflicting values. Reports have been prepared and distributed for the Sabine, Neches, San Jacinto, Trinity, Lavaca, Guadalupe, San Antonio, and Coastal basins. The report on the drainage area of the Brazos River basin was completed during fiscal year 1976 and will be published in 1977.

REPORTS IN PREPARATION, RELEASED, OR PUBLISHED DURING FISCAL YEAR 1977

Basic-Data Reports

Water Resources Data for Texas

Water resources data for Texas, water year 1975 (October 1974 - September 1975), volumes 1-3, published as U.S. Geological Survey Water-Data Report TX 75-1.

Water resources data for Texas, water year 1976 (October 1975 - September 1976), volumes 1-3, will be published as a U.S. Geological Survey Water-Data Report TX 76-1.

Hydrologic Studies of Small Watersheds

Hydrologic data for Cow Bayou, Brazos River basin, Texas, 1974. Limited number of copies reproduced as a U.S. Geological Survey open-file report.

Hydrologic data for Little Elm Creek, Trinity River basin, Texas, 1974. Limited number of copies reproduced as a U.S. Geological Survey open-file report.

Hydrologic data for Mountain Creek, Trinity River basin, Texas, 1974. Limited number of copies reproduced as a U.S. Geological Survey open-file report.

Hydrologic data for North Creek, Trinity River basin, Texas, 1974. Limited number of copies reproduced as a U.S. Geological Survey open-file report.

Hydrologic data for Cow Bayou, Brazos River basin, Texas, 1975. Limited number of copies to be reproduced by the Texas District.

Hydrologic data for Little Elm Creek, Trinity River basin, Texas, 1975. Limited number of copies to be reproduced by the Texas District.

Hydrologic data for Mountain Creek, Trinity River basin, Texas, 1975. Limited number of copies to be reproduced by the Texas District.

Hydrologic data for North Creek, Trinity River basin, Texas, 1975. Limited number of copies to be reproduced by the Texas District.

Urban-Hydrology Studies

Hydrologic data for urban studies in the Austin, Texas, metropolitan area, 1974. Limited number of copies reproduced as a U.S. Geological Survey open-file report.

Hydrologic data for urban studies in the Dallas, Texas, metropolitan area, 1974. Limited number of copies reproduced as a U.S. Geological Survey open-file report.

Hydrologic data for urban studies in the Fort Worth, Texas, metropolitan area, 1974. Limited number of copies reproduced as a U.S. Geological Survey open-file report.

Hydrologic data for urban studies in the Houston, Texas, metropolitan area, 1974. Limited number of copies reproduced as a U.S. Geological Survey open-file report.

Hydrologic data for urban studies in the San Antonio, Texas, metropolitan area, 1974. Limited number of copies reproduced as a U.S. Geological Survey open-file report.

Hydrologic data for urban studies in the Austin, Texas, metropolitan area, 1975. Limited number of copies to be reproduced by the Texas District.

Hydrologic data for urban studies in the Dallas, Texas, metropolitan area, 1975. Limited number of copies to be reproduced by the Texas District.

Hydrologic data for urban studies in the Fort Worth, Texas, metropolitan area, 1975. Limited number of copies to be reproduced by the Texas District.

Hydrologic data for urban studies in the Houston, Texas, metropolitan area, 1975. Limited number of copies to be reproduced by the Texas District.

Hydrologic data for urban studies in the San Antonio, Texas, metropolitan area, 1975. Limited number of copies to be reproduced by the Texas District.

Flood Stages and Discharges for Small Streams in Texas (Highway Program)

Technique for estimating the magnitude and frequency of floods in Texas. This report will be released as a Geological Survey open-file report and will be published as a U.S. Geological Survey Water-Resources Investigations Report.

Application of the U.S. Geological Survey rainfall-runoff model in estimating flood peaks for selected small drainage basins in Texas. This report will be published as a U.S. Geological Survey Water-Resources Investigations Report.

Water-Quality Basic-Data Reports

Water-quality records for selected reservoirs in Texas, 1974-75 water years. This report will be published as a Texas Water Development Board report.

Chemical and bacteriological quality of water at selected sites in the San Antonio area, Texas, August 1968-January 1975. This report was published as a bulletin of the Edwards Underground Water District.

Chemical and physical characteristics of water in estuaries of Texas, October 1971 - September 1973. This report was published as Texas Water Development Board Report 208.

Chemical and physical characteristics of water in estuaries in Texas, October 1973 - September 1974. This report will be published as a Texas Water Development Board report.

Quality of water in Lake Livingston. This report will be published as a Texas Water Development Board report.

Data on water quality and hydrodynamics at the Bolivar Peninsula wetland-habitat development site, Galveston Bay, Texas. This report will be published as a U.S. Army Corps of Engineers technical report.

Sediment data for selected sites in Texas. This report will be released as a U.S. Geological Survey open-file report.

Quality of water in Belton Lake, central Texas. This report will be published as a Texas Water Development Board report.

Chemical and bacteriological quality of water at selected sites in the San Antonio area, Texas, February 1975 - December 1976. This report will be published as a bulletin of the Edwards Underground Water District.

Quality of water in the Guadalupe estuary, Texas. This report will be published as a Texas Water Development Board report.

Ground-Water and Other Basic-Data Reports

Records of wells, drillers' logs, water-level measurements, and chemical analyses of ground water in Brazoria, Fort Bend, and Waller Counties, Texas, 1966-74. This report was published as Texas Water Development Board Report 201.

Records of wells, drillers' logs, water-level measurements, and chemical analyses of ground water in Chambers, Liberty, and Montgomery Counties, Texas, 1966-74. This report was published as Texas Water Development Board Report 202.

Records of wells, drillers' logs, water-level measurements, and chemical analyses of ground water in Harris and Galveston Counties, Texas, 1970-74. This report was published as Texas Water Development Board Report 203.

Ground-water data for the Orange County area, Texas and Louisiana, 1971-74. This report was published as a Texas Water Development Board Report 197.

Ground-water data for the Salt Basin, Eagle Flat, Red Light Draw, Green River Valley, and Presidio Bolson in westernmost Texas. This report will be released as a U.S. Geological Survey open-file report.

Ground-water development in the Houston district, Texas, 1970-74. This report will be published as a Texas Water Development Board report.

Ground-water discharge from the Edwards and associated limestones, San Antonio area, Texas, 1975. This report was published as Bulletin 35 of the Edwards Underground Water District.

Ground-water discharge from the Edwards and associated limestones, San Antonio area, Texas, 1976. This report will be published as a bulletin of the Edwards Underground Water District.

Analytical or Interpretive Reports

Ground-water resources of Colorado, Lavaca, and Wharton Counties, Texas. This report will be published as a Texas Water Development Board report.

Artifical ground-water recharge as a water-management technique on the Southern High Plains of Texas and New Mexico. This report will be published as a Texas Water Development Board report.

Stratigraphic and hydrogeologic framework of part of the Coastal Plain of Texas. This report will be published as a Texas Water Development Board report.

Digital model for simulated effects of ground-water pumping in the Hueco Bolson, El Paso area, Texas, New Mexico, and Mexico. This report was published as U.S. Geological Survey Water-Resources Investigations Report 58-75.

Hydrologic interpretation of geophysical data from the Southeastern Hueco Bolson, El Paso and Hudspeth Counties, Texas. This report was released as U.S. Geological Survey Open-File Report 76-650.

Availability of fresh and slightly saline ground water in the basins of westernmost Texas. This report will be published as a Texas Water Development Board report.

Land-surface subsidence at Seabrook, Texas. This report was published as U.S. Geological Survey Water-Resources Investigations Report 76-31.

Land-surface subsidence in the area of Moses Lake near Texas City, Texas. This report was published as U.S. Geological Survey Water-Resources Investigations Report 76-32.

Progress report on the geology of the Edwards aquifer, San Antonio area, Texas, and preliminary interpretation of borehole geophysical and laboratory data on carbonate rocks. This report was released as U.S. Geological Survey Open-File Report 76-627.

Methods of estimating natural ground-water recharge to the Edwards aquifer, San Antonio area, Texas. This report will be published as a U.S. Geological Survey Water-Resources Investigations report.

Statistical analysis of springflow, streamflow, and water-level data for the Edwards aquifer in South-Central Texas. This report was published as a bulletin of the Edwards Underground Water District.

Summary appraisals of the Nation's ground-water resources--Texas-Gulf region. This report was published as U.S. Geological Survey Professional Paper 813-F.

Digital-model and earth-resistivity studies of the Lower Mesilla Valley of the Rio Grande, Texas and New Mexico. This report will be released as a U.S. Geological Survey open-file report.

Time of travel of solutes in the East Fork Trinity River, November 1975; and Elm Fork Trinity River, December 1975; Trinity River basin, Texas. This report was released as U.S. Geological Survey Open-File Report 76-683.

Drainage areas of Texas streams, Brazos River basin. This report will be released as a U.S. Geological Survey open-file report.

Artificial recharge for subsidence abatement at the NASA-Johnson Space Center, Phase I. This report will be released as a U.S. Geological Survey open-file report.

Test drilling for ground water in Hudspeth, Culberson, and Presidio Counties, Texas. This report was released as a U.S. Geological Survey open-file report.

Salt-water encroachment in aquifers near the Houston Ship Channel, Texas. This report was released as U.S. Geological Survey Open-File Report 76-781.

Bibliographic Reports

Annotated bibliography of water-resources publications and open-file reports for Texas by the Texas Water Development Board and the U.S. Geological Survey through September 1974. This report was published as Texas Water Development Board Report 199.

Bibliography of U.S. Geological Survey reports on the geology and water resources of Texas, 1887-1974. This report was published as U.S. Geological Survey Water-Resources Investigations Report 20-75.

SELECTED LIST OF AVAILABLE REPORTS OF GENERAL INTEREST

U.S. Geological Survey Circular 721: Earth-science information in land-use planning--guidelines for earth scientists and planners, by William Spangle and associates; F. B. Leighton and Associates; and Baxter, McDonald, and Company. Free on application to U.S. Geological Survey, Reston, Virginia 22092

U.S. Geological Survey Circular 731: A guide to State programs for the reclamation of surface mined areas, by E. A. Imhoff, T. O. Friz, and J. R. LaFevers. Free on application to U.S. Geological Survey, Reston, Virginia 22092

U.S. Geological Survey Circular 737: Status of ground-water modeling in the U.S. Geological Survey, by C. A. Appel and J. D. Bredehoeft. Free on application to U.S. Geological Survey, Reston, Virginia 22092.

U.S. Geological Survey Professional Paper 813-F: Summary appraisals of the Nation's ground-water resources--Texas-Gulf region, by E. T. Baker, Jr., and J. R. Wall. Available from U.S. Geological Survey Public Inquiries Office[1/] - $2.45

U.S. Geological Survey Professional Paper 813-H: Summary appraisals of the Nation's ground-water resources--Arkansas-White-Red region, by M. S. Bedinger and R. T. Sniegocki. Available from U.S. Geological Survey Public Inquiries Office[1/] - 85¢

U.S. Geological Survey Professional Paper 909: Boundaries of the United States and the Several States by Franklin K. Van Zandt. Available from U.S. Geological Survey Public Inquiries Office[1/] - $5.20

U.S. Geological Survey Professional Paper 929: ERTS-1 A new window on our planet, by Richard S. Williams, Jr., and William D. Carter, editors. Available from U.S. Geological Survey Public Inquiries Office[1/] - $13.00

U.S. Geological Survey Professional Paper 964: A land use and land cover classification system for use with remote sensor data, by J. R. Anderson, E. E. Hardy, J. T. Roach, and R. E. Witmer. Available from U.S. Geological Survey Public Inquiries Office[1/] - 75¢

U.S. Geological Survey Professional Paper 975: Geological Survey Research 1975. Available from U.S. Geological Survey Public Inquiries Office[1/] - $5.00

U.S. Geological Survey Water-Supply Paper 2172: Ground-water levels in the United States, 1970-74, South-Central States. Available from U.S. Geological Survey Public Inquiries Office[1/] - $2.50

SUMMARY OF COOPERATION

Organizations assisting in collecting data under cooperative agreements with the Geological Survey are:

Texas Water Development Board. James M. Rose, Executive Director; A. L. Black, Chairman; Robert B. Gilmore, Vice-Chairman; Milton T. Potts, John H. Garrett, George W. McCleskey, and John H. Garrett, Members.

Texas Department of Highways and Public Transportation. B. L. DeBerry, Engineer-Director; Reagan Houston, Chairman; Charles E. Simon and Dewitt C. Greer, Members.

Pecos River Commission. Horace M. Babcock, Commissioner representing the United States and Chairman; R. B. McGowen, Jr., Commissioner representing Texas; and John B. Walker, Commissioner representing New Mexico.

Sabine River Administration. Harry S. Dent, Commissioner representing the United States and Chairman; R. J. Palmer and D. V. Cresap for Louisiana; and J. M. Syler and George Smith for Texas.

County of Dallas. C. Judson Shook, Jr., Director of Public Works.

City of Austin. Charles B. Graves, Jr., Director of Engineering.

City of Dallas. Monroe McCorkle, Director of Public Works.

City of Fort Worth. Jack M. Graham, Director of Public Works.

City of Houston. E. B. Cape, Director of Public Works.

1/ For publications available from U.S. Geological Survey Public Inquiries Office, order should be addressed to: U.S. Geological Survey Public Inquiries Office, Room 1 C 45, 1100 Commerce Street, Dallas, Texas 75201.

Assistance in the form of funds or services is furnished by the following Federal agencies:

Department of Housing and Urban Development.

Environmental Protection Agency.

International Boundary and Water Commission, United States and Mexico, U.S. Section.

National Aeronautics and Space Administration.

Soil Conservation Service, Department of Agriculture.

U.S. Army, Corps of Engineers, Albuquerque District, New Mexico.

U.S. Army, Corps of Engineers, Fort Worth District, Texas.

U.S. Army, Corps of Engineers, Galveston District, Texas.

U.S. Army, Corps of Engineers, Little Rock District, Arkansas.

U.S. Army, Corps of Engineers, New Orleans District, Louisiana.

U.S. Army, Corps of Engineers, Tulsa District, Oklahoma.

Assistance in the form of funds or services is rendered by the following organizations through the Texas Water Development Board:

Cities

Abilene
Alice
Arlington
Austin
Brady
Cleburne
Clyde
Corpus Christi
Dallas
El Paso
Gainesville
Graham
Houston
Nacogdoches
San Angelo
Wichita Falls

Other Cooperators

Athens Municipal Water Authority

Bexar-Medina-Atascosa Counties Water Improvement District No. 1

Bistone Municipal Water Supply District

Brazos River Authority

Chocolate Bayou Company

Colorado River Municipal Water District

Dallas County

Dallas Power and Light Company

Dayton Canal Company

Dow Chemical Company

Edwards Underground Water District

Franklin County Water District

Freese and Nichols

Greenbelt Municipal and Industrial Water Authority

Guadalupe-Blanco River Authority

Harris County Flood Control District

Harris-Galveston Coastal Subsidence District

Houston Lighting and Power Company

Lone Star Steel Company

Lower Colorado River Authority

Lower Neches Valley Authority

MacKenzie Municipal Water Authority

North Central Texas Council of Governments

North Central Texas Municipal Water Authority

Northeast Texas Municipal Water District

Palo Pinto County Municipal Water District No. 1

Red Bluff Water Power Control District

Reeves County Water Improvement District No. 1

Richmond Rice Association

Sabine River Authority of Texas

San Antonio City Public Service Board

San Antonio City Water Board

San Antonio River Authority

San Jacinto River Authority

Tarrant County Water Control and Improvement District No. 1

Texas Electric Service Company

Texas Utilities Services Inc.

The Woodlands Development Corporation

Tom Green County Water Control and Improvement District No. 1

Trinity River Authority of Texas

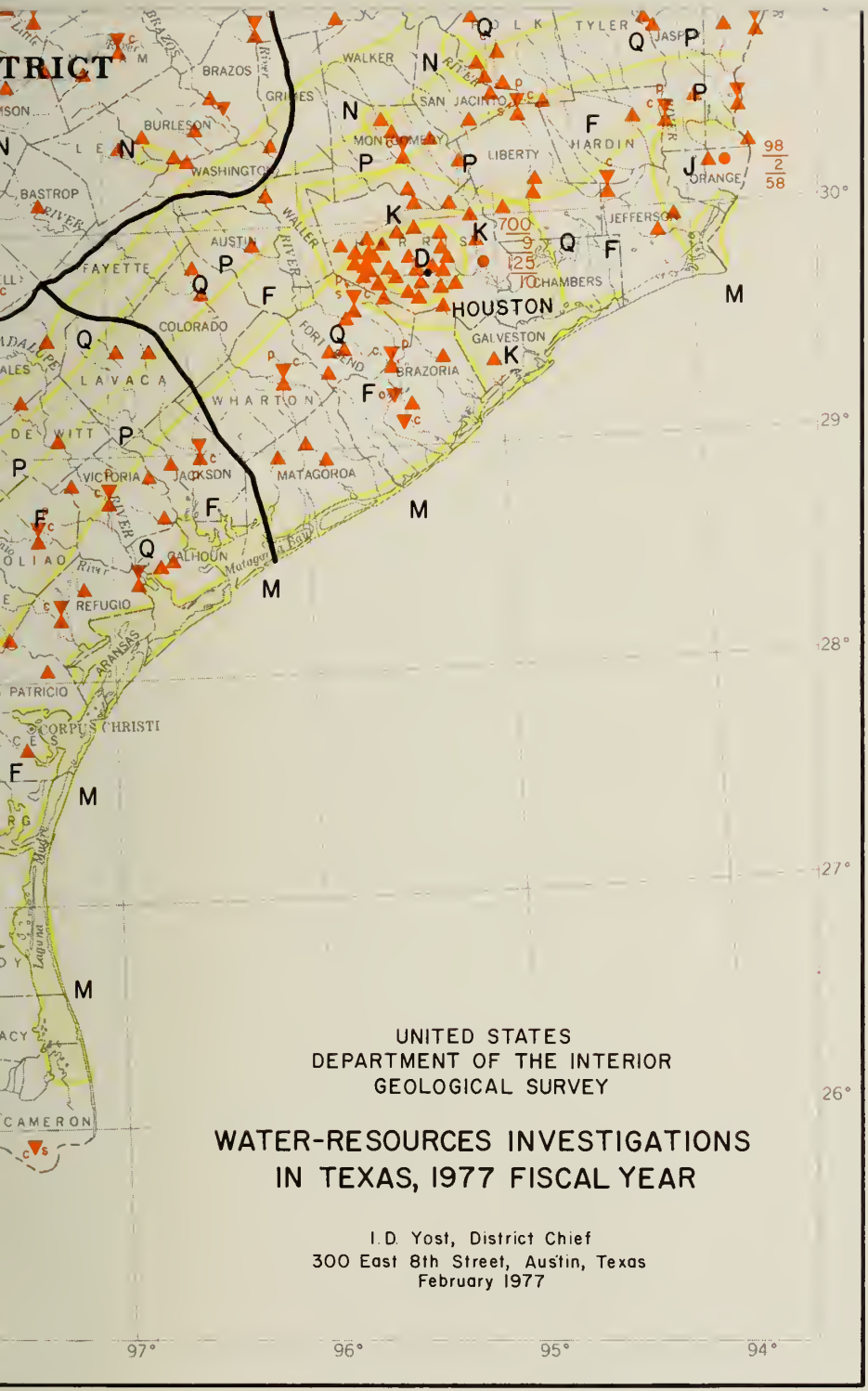
Upper Guadalupe River Authority

West Central Texas Municipal Water District

White River Municipal Water District

Wichita County Water Improvement District No. 2

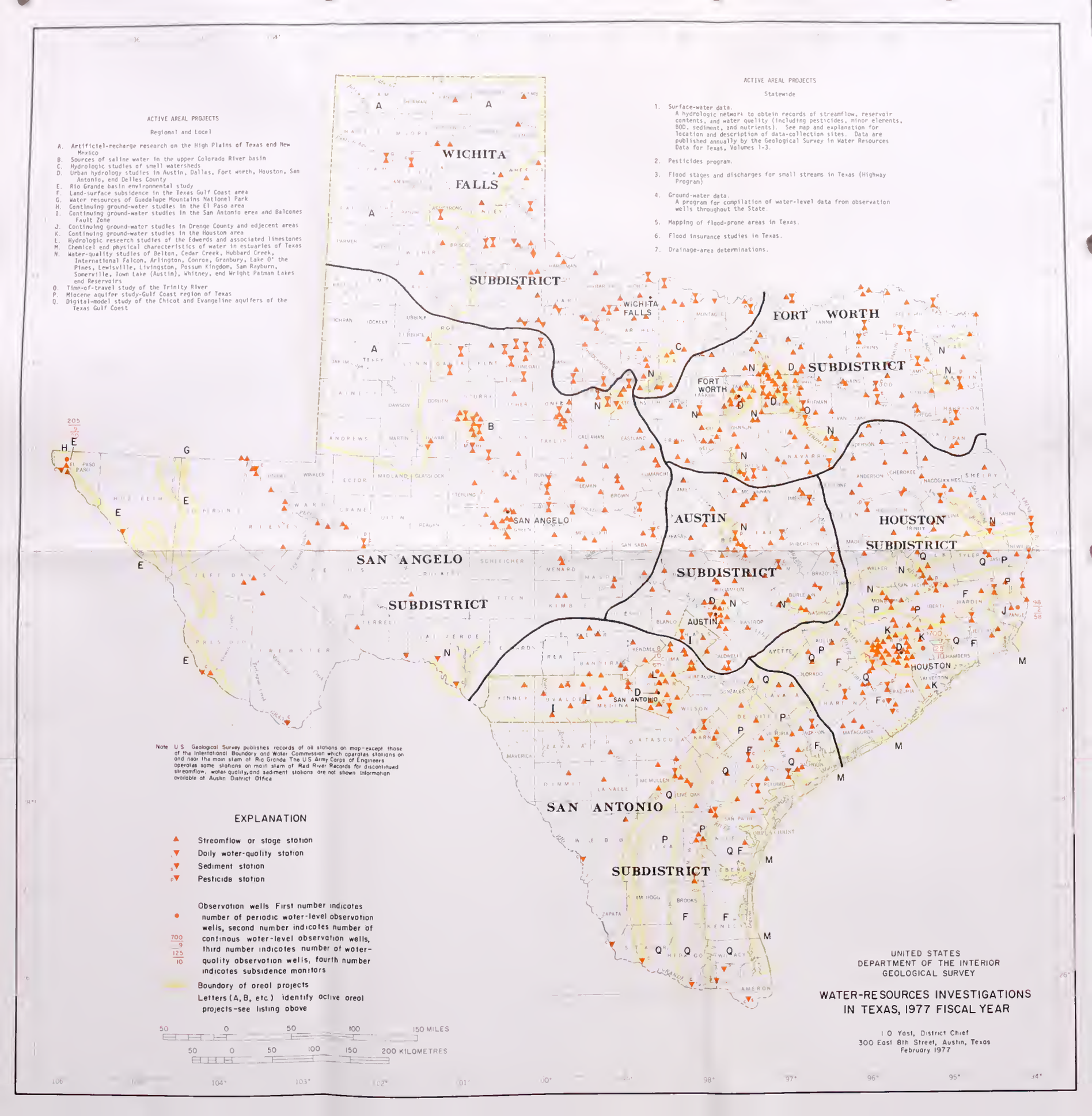
Wood County



UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

WATER-RESOURCES INVESTIGATIONS IN TEXAS, 1977 FISCAL YEAR

I.D. Yost, District Chief
300 East 8th Street, Austin, Texas
February 1977


ACTIVE AREAL PROJECTS
Regional and Local
A. Artificial-recharge research on the High Plains of Texas and New Mexico
B. Sources of saline water in the upper Colorado River basin
C. Hydrologic studies of small watersheds
D. Urban hydrology studies in Austin, Dallas, Fort Worth, Houston, San Antonio, and Dalles County
E. Rio Grande basin environmental study
F. Land-surface subsidence in the Texas Gulf Coast area
G. Water resources of Guadalupe Mountains National Park
H. Continuing ground-water studies in the El Paso area
I. Continuing ground-water studies in the San Antonio area and Balcones Fault Zone
J. Continuing ground-water studies in Orange County and adjacent areas
K. Continuing ground-water studies in the Houston area
L. Hydrologic research studies of the Edwards and associated limestones
M. Chemical and physical characteristics of water in estuaries of Texas
N. Water-quality studies of Belton, Cedar Creek, Hubbard Creek, International Falcon, Arlington, Conroe, Granbury, Lake O' the Pines, Lewisville, Livingston, Possum Kingdom, Sam Rayburn, Somerville, Town Lake (Austin), Whitney, and Wright Patman Lakes and Reservoirs
O. Time-of-travel study of the Trinity River
P. Miocene aquifer study-Gulf Coast region of Texas
Q. Digital-model study of the Chicot and Evangeline aquifers of the Texas Gulf Coast
ACTIVE AREAL PROJECTS
Statewide
1. Surface-water data.
A hydrologic network to obtain records of streamflow, reservoir contents, and water quality (including pesticides, minor elements, BOD, sediment, and nutrients). See map and explanation for location and description of data-collection sites. Data are published annually by the Geological Survey in Water Resources Data for Texas, Volumes 1-3.
2. Pesticides program.
3. Flood stages and discharges for small streams in Texas (Highway Program)
4. Ground-water data.
A program for compilation of water-level data from observation wells throughout the State.
5. Mapping of flood-prone areas in Texas.
6. Flood insurance studies in Texas.
7. Drainage-area determinations.
WICHITA FALLS SUBDISTRICT
FORT WORTH SUBDISTRICT
AUSTIN SUBDISTRICT
HOUSTON SUBDISTRICT
SAN ANGELO SUBDISTRICT
SAN ANTONIO SUBDISTRICT
Note U.S. Geological Survey publishes records of all stations on map-except those of the International Boundary and Water Commission which operates stations on and near the main stem of Rio Grande The U.S. Army Corps of Engineers operates some stations on main stem of Red River Records for discontinued streamflow, water quality, and sediment stations are not shown Information available at Austin District Office
EXPLANATION
Streamflow or stage station
Daily water-quality station
Sediment station
Pesticide station
Observation wells First number indicates number of periodic water-level observation wells, second number indicates number of continous water-level observation wells, third number indicates number of water-quality observation wells, fourth number indicates subsidence monitors
700 / 9 / 125 / 10
Boundary of areal projects
Letters (A, B, etc.) identify active areal projects-see listing above
50 0 50 100 150 MILES
50 0 50 100 150 200 KILOMETRES
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WATER-RESOURCES INVESTIGATIONS IN TEXAS, 1977 FISCAL YEAR
I O Yost, District Chief
300 East 8th Street, Austin, Texas
February 1977

UNIVERSITY OF ILLINOIS-URBANA
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